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DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

RECHARGE ZONE OF THE EDWARDS AQUIFER HYDROLOGICALLY ASSOCIATED WITH BARTON SPRINGS IN THE AUSTIN AREA, TEXAS

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By
DIANA L. SLAGLE, ANN F. ARDIS, AND RAYMOND M. SLADE, JR.

U.S. GEOLOGICAL SURVEY
WATER-RESOURCES INVESTIGATIONS
REPORT 86-4062

PREPARED IN COOPERATION WITH THE
CITY OF AUSTIN, TEXAS

1986

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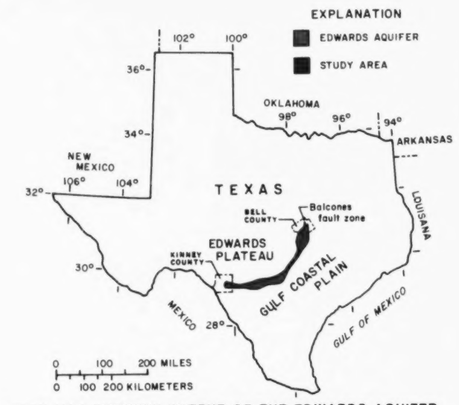

INDEX MAP SHOWING EXTENT OF THE EDWARDS AQUIFER

INTRODUCTION

The Edwards aquifer extends in a narrow belt from Bell County in the northeast to Kinney County in the southwest (index map) and provides water for at least nine counties in south-central Texas. Hydrologic boundaries divide the Edwards aquifer into several parts. This study focuses on the Edwards aquifer in the Austin area for which Barton Springs is the major discharge point (Slade, Dorsey, and Stewart, in press). This part of the Edwards aquifer provides the municipal, industrial, domestic, and agricultural water supplies for about 30,000 people in the Austin area (southern Travis and northern Hays Counties). Discharge from Barton Springs sustains streamflow at the mouth of Barton Creek and flows into Town Lake. Much of the land use within the outcrop area of the Edwards aquifer near Austin is rapidly changing from natural woodland and grassland to commercial and residential developments. Because urban development can result in a substantial degradation of the quality of water that recharges the aquifer, the extent of the recharge zone of the Edwards aquifer was delineated to provide information to the City of Austin for their use in formulating a plan for protecting and managing ground-water quality.

The purpose of this report is to define and delineate the areal extent of the recharge zone of the Edwards aquifer in southern Travis and northern Hays Counties. The areal boundary of the recharge zone was determined by: (1) Geologic mapping of the aquifer area; (2) interpretation of aerial photographs; (3) field verification of existing geologic maps (Barnes, 1974; DeCook, 1960; Garner and Young, 1976; Rodda and others, 1970; and Smith, 1978); and (4) streamflow-loss studies (Slade, Dorsey, and Stewart, in press).

The authors are indebted to the many landowners who permitted access to their property. The Public Works Department of the City of Austin provided cooperative funding for this report, and Fred Snyder, a geologist with the City of Austin Planning and Growth Management Department, was particularly helpful in assisting with some of the geologic mapping.

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CONVERSION FACTORS

For use of readers who prefer to use metric units, conversion factors for terms used in this report are listed below:

Multiply	By	To obtain
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)

GEOLOGY

The Edwards aquifer is in an area locally known as the Balcones fault zone which separates the Edwards Plateau from the Gulf Coastal Plain (index map). This fault zone is a series of normal, stair-stepped, down-to-the-coast faults which trend to the east and the northeast. In the study area, the faulting has juxtaposed the Edwards aquifer against younger, relatively impermeable clays, limestones, and marls to the east, and against older, less permeable limestones to the west. Vertical displacement along the faults is as much as 200 feet; however, there is no evidence that the aquifer is completely offset by the fault zone (generalized hydrogeologic section). The lithologic descriptions used in this report are adapted from Rodda and others (1970), Garner and Young (1976), and Brune and Duffin (1983).

SYSTEM	FORMATION	HYDROGEOLOGIC UNIT
CRETACEOUS	BUDA LIMESTONE	UPPER CONFINING BED
	DEL RIO CLAY	
	GEORGETOWN LIMESTONE	
	EDWARDS LIMESTONE	AQUIFER
	WALNUT FORMATION	LOWER CONFINING BED
	GLEN ROSE LIMESTONE	

GENERALIZED HYDROGEOLOGIC COLUMN SHOWING THE EDWARDS AQUIFER AND ITS CONFINING BEDS AND THE CORRELATIVE FORMATIONS

The Edwards aquifer is composed of the Georgetown Limestone and underlying Edwards Limestone, both of Cretaceous age (generalized hydrogeologic column). The Georgetown Limestone ranges in thickness from 40 to 100 feet in the subsurface, and consists of thin interbeds of fossiliferous limestone and marly limestone. The Edwards Limestone ranges in thickness from about 300 to 350 feet in the subsurface, and is composed of thick to thin-bedded limestone and dolomitic limestone containing solution-collapse zones that create cavernous and vugular porosity. The Del Rio Clay confines the top of the Edwards aquifer, and is composed of a calcareous, fossiliferous clay which is 60 to 75 feet thick in the subsurface. The Buda Limestone, stratigraphically above the Del Rio Clay, consists of an upper hard, resistant, glauconitic, shell-fragment limestone and a lower marly, nodular, less resistant limestone. It has a total thickness ranging from 35 to 50 feet in the subsurface. The Walnut Formation, which confines the base of the aquifer, ranges in thickness from 15 to 60 feet in the subsurface, and is composed of a fossiliferous limestone and layers of marl, marly limestone, and nodular limestone. The Glen Rose Limestone stratigraphically below the Walnut Formation, ranges in thickness from 500 to 900 feet in the subsurface, and consists of alternating beds of limestone, dolomite, and marl.

The outcrop area of the Georgetown and Edwards Limestones within the study area is shown on the geohydrologic map (Ardis, Slagle, and Snyder, 1985). The northern and southern limits of the outcrop area shown on the map are defined by hydrologic boundaries--the Colorado River on the north and a ground-water divide on the south--and not by geologic boundaries. The eastern boundary is the depositional contact between the outcrops of the Georgetown Limestone and the Del Rio Clay, or fault contacts between the Georgetown or Edwards Limestones and younger formations (Del Rio Clay or Buda Limestone). Isolated outcrops of the aquifer that exist east of the delineated boundary are included on the map. The western boundary is the geologic contact between the outcrop of the Edwards Limestone and older formations (the Glen Rose Limestone or the Walnut formation). This boundary coincides with the western boundary of the aquifer, and for the most part, is controlled by the Mount Bonnell fault.

HYDROGEOLOGIC SETTING

The Edwards aquifer hydrologically associated with Barton Springs extends from the Colorado River on the north to the City of Kyle on the south, and underlies parts of Travis and Hays Counties. The northern boundary of the aquifer is a hydrologic boundary formed by the Colorado River; the southern boundary is a ground-water divide within the Edwards aquifer; the eastern boundary is the downdip limit of freshwater (concentration of dissolved solids less than 1,000 milligrams per liter), locally known as the "bad-water" line (Andrews and others, 1984); and the western boundary is the westernmost occurrence of contiguous Edwards Limestone, and commonly coincides with the Mount Bonnell and associated faults. Isolated outliers of the Edwards Limestone exist west of the Mount Bonnell and associated faults, but are not considered to be part of the Edwards aquifer.

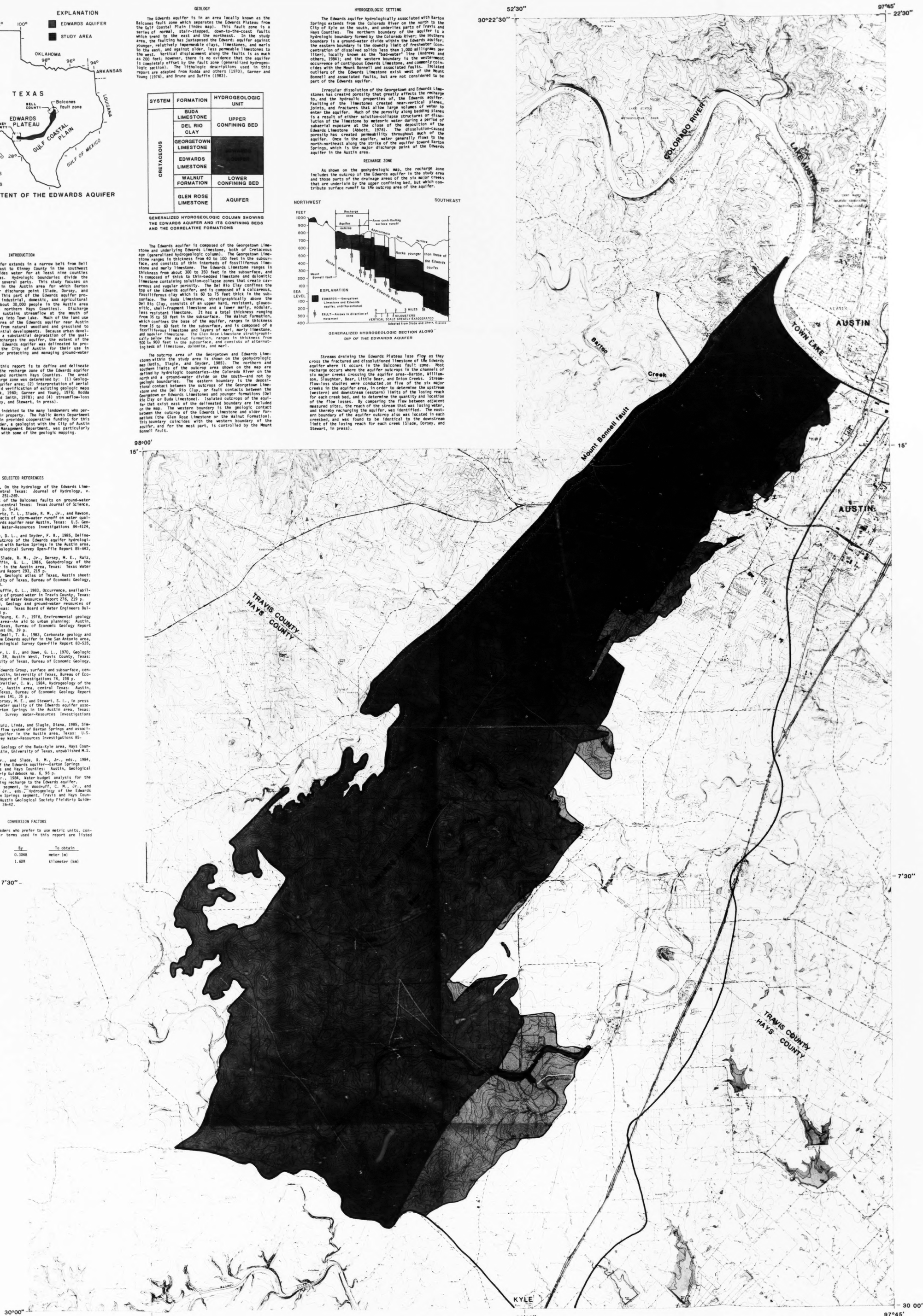
Irregular dissolution of the Georgetown and Edwards Limestones has created porosity that greatly affects the recharge to, and the hydraulic properties of, the Edwards aquifer. Faulting of the limestones created near-vertical planes, joints, and fractures that allow large volumes of water to enter the aquifer. Much of the porosity along bedding planes is a result of either solution-collapse structures or dissolution of the limestone by meteoric water during a period of subaerial exposure at the close of the deposition of the Edwards Limestone (Abbott, 1976). The dissolution-caused porosity has created permeability throughout much of the aquifer. Once in the aquifer, water generally flows to the north-northeast along the strike of the aquifer toward Barton Springs, which is the major discharge point of the Edwards aquifer in the Austin area.

RECHARGE ZONE

As shown on the geohydrologic map, the recharge zone includes the outcrop of the Edwards aquifer in the study area and those parts of the drainage areas of the six major creeks that are underlain by the upper confining bed, but which contribute surface runoff to the outcrop area of the aquifer.

GENERALIZED HYDROGEOLOGIC SECTION ALONG DIP OF THE EDWARDS AQUIFER

Streams draining the Edwards Plateau lose flow as they cross the fractured and dissolutioned limestone of the Edwards aquifer where it occurs in the Balcones fault zone. Most recharge occurs where the aquifer outcrops in the channels of six major creeks crossing the aquifer area--Barton, Williamson, Slaughter, Bear, Little Bear, and Onion Creeks. Streamflow-loss studies were conducted on five of the six major creeks in the aquifer area, in order to determine the upstream (western) and downstream (eastern) limits of the losing reach for each creek bed, and to determine the quantity and location of the flow losses. By comparing the flow between adjacent measured sites, the reach of the stream that was losing water, and thereby recharging the aquifer, was identified. The eastern boundary of the aquifer outcrop also was located in each creekbed, and was found to be identical to the downstream limit of the losing reach for each creek (Slade, Dorsey, and Stewart, in press).



GEOHYDROLOGIC MAP

SCALE 1:48,000
0 1 2 MILES
0 1 2 KILOMETERS

CONTOUR INTERVALS 10 AND 20 FEET
DATUM IS SEA LEVEL

EXPLANATION

BOUNDARY OF THE EDWARDS AQUIFER HYDROLOGICALLY ASSOCIATED WITH BARTON SPRINGS--From Andrews and others (1984)

RECHARGE ZONE

Outcrop of the Georgetown and Edwards Limestones, which constitute the Edwards aquifer. Boundary dashed where inferred

Part of drainage area of major creek that is underlain by the upper confining bed, but which contributes surface runoff either to outcrop of Edwards aquifer or to losing reach of creek

Base from U.S. Geological Survey,
1:24,000 quadrangle maps:
Austin West, 1952 (Photorevised 1973), Driftwood, 1958,
Signal Hill, 1967 (Photorevised 1973), Mountain City, 1967 (Photorevised 1973),
Oak Hill, 1954 (Photorevised 1973), and Buda, 1967 (Photorevised 1973)

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